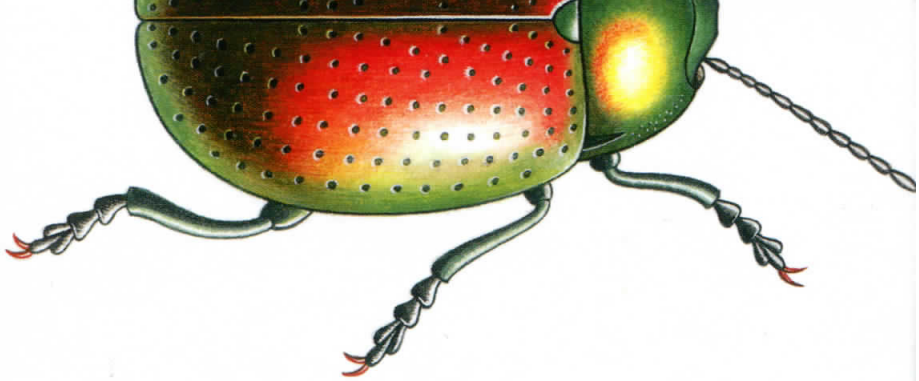


Collins · FIELD GUIDE

INSECTS

of Britain and Northern Europe

MICHAEL CHINERY

3rd Edition

Introduction

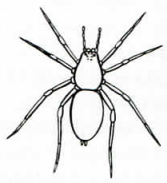
Throughout recorded history insects have been both the delight and despair of mankind. No other group of living creatures has such variety of form, colour, function, and habitat and, although the insects are often persecuted as pests or simply dismissed as commonplace 'creepy-crawlies', many people love them. Not least among these is the 'bug-hunter', and it is hoped that this book will be of some service to him or her, be he or she amateur or professional.

It is impossible to give a simple definition of insects beyond the fact that most of them have six legs at some time in their lives. There are so many kinds of insects – 30 million different species according to one estimate, although the real total is likely to be between one million and ten million species – that no simple definition could possibly take in all the variations. The best that can be done is to list those features of insects that distinguish them from other animals.

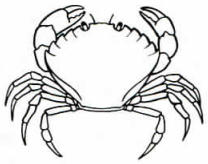
Insects belong to the large animal phylum called the Arthropoda – a name that refers to the jointed limbs and body. The arthropod body is covered by a tough shell or skeleton, and flexible joints between the skeletal plates allow the animal to move. As well as the insects, the arthropods include the crustaceans (crabs, shrimps, woodlice, etc), the myriapods (centipedes and millipedes), and the arachnids (spiders, scorpions, mites, etc). It is with these groups that the insects – especially the wingless ones – are most likely to be confused and the figures below show the main features by which each group can be distinguished.

An insect's body is divided into three regions – head, thorax, and abdomen. The head bears one pair of antennae and the thorax usually carries three pairs of legs – hence the alternative name Hexapoda (= six feet) for the insects. Wings are usually present on the thorax. All winged arthropods – in fact, all winged invertebrates – are insects, but this does not mean that all insects have wings. You will see many wingless creatures in the pages of this book, but they are just as much insects as the more familiar butterflies and moths. The three body regions and the three pairs of legs prove their identity.

Insect: 3 pairs of legs: 3 body divisions: usually winged

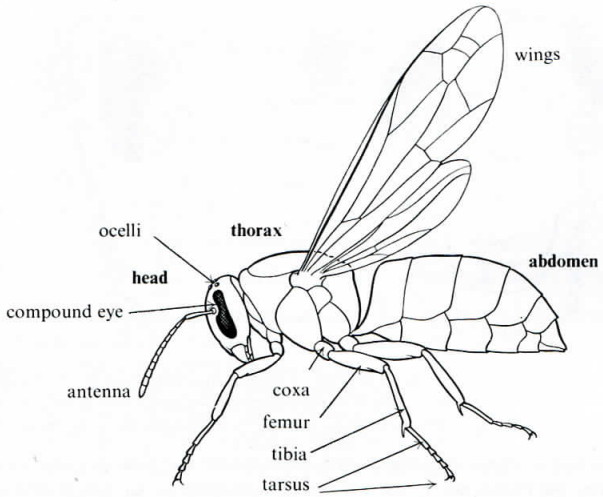


Arachnid: 4 pairs of legs: no antennae, though palps may resemble antennae: no wings



Crustacean: several pairs of legs: 2 pairs of antennae: no wings

Myriapod (centipede): many pairs of legs: no wings



A typical insect showing the major components of the insect body

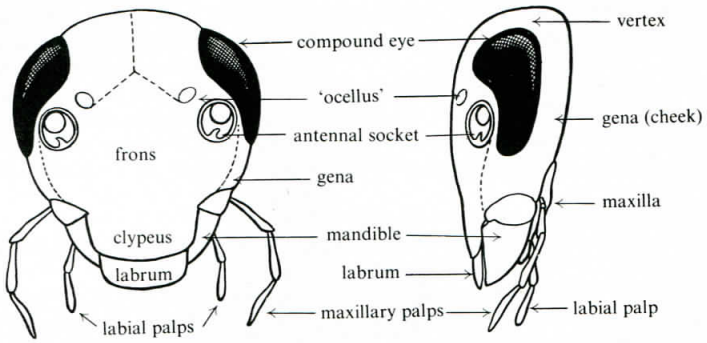
legs. One or two pairs of wings are also usually present on the thorax. The adult abdomen has no legs, although it may carry a number of cerci or other outgrowths at the hind end.

Like all arthropods, the insect has a segmented body composed of a number of fundamentally similar rings or segments. There are basically 20 segments in the insect body – six in the head, three in the thorax, and eleven in the abdomen – but some are fused together and it is not possible to count them all.

The body wall consists largely of the cuticle, which is a complex non-cellular layer secreted mainly by the cells of the underlying epidermis. The major component of the cuticle is the nitrogenous polysaccharide known as chitin, which forms up to 60 per cent of the cuticle's dry weight. It is bound up with various proteins. In most segments the cuticle becomes hardened to form the tough plates called sclerites. This is brought about by a process of tanning, in which neighbouring protein chains become linked together. Between the segments the cuticle remains soft and flexible, forming the joints which enable the body to move. One of the most interesting materials in the cuticle is a rubber-like protein called resilin. It occurs mainly in the thorax, where its almost perfect elastic recovery after distortion makes it the ideal material for the wing-hinges.

The Head The six segments of the head are intimately welded together to form a rather tough capsule. This carries many grooves or sutures but these do not necessarily correspond with the original segments and sclerites of which the head is formed. The figure shows the basic head structure of a cockroach, which is regarded as a rather primitive and generalised insect. The regions shown can be distinguished in most other insects but the pattern is often complicated by the fusion and/or sub-division of various sclerites.

Insects have no internal jaws like our own and the limbs of the head segments have been modified to assist in the capture and eating of food. All cutting and chew-

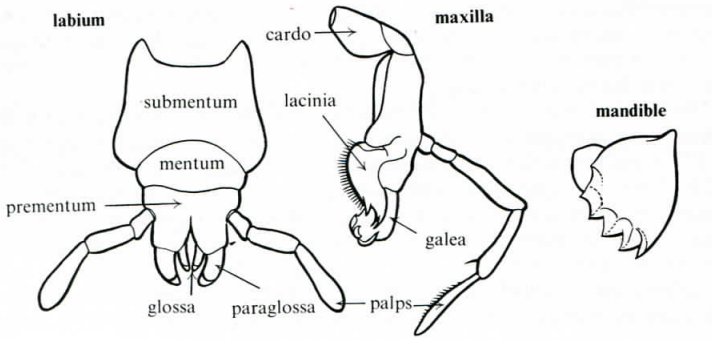


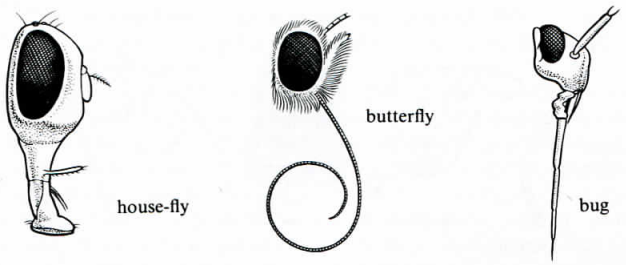
Front and side views of a cockroach head - a typical hypognathous head with the mouth-parts below the eyes. The ocelli of the cockroach are actually very poorly developed and are usually represented by little more than two pale patches near the antennae

ing is performed by these external mouth-parts before the food is passed into the mouth. Again, the cockroach reveals the basic structure. Its simple, biting mouth-parts, unspecialised and suited to a wide variety of food materials, are believed to be similar to those of the earliest insects.

The paired mandibles are the cutting parts of the feeding apparatus and are usually simply called the jaws. They are hard and heavily sclerotised and commonly toothed, and they are often provided with powerful muscles. Many of our larger insects can give the handler a painful nip: the Wart-biter, a bush-cricket rare in the British Isles, gets its name from the old Swedish custom of encouraging this insect to bite off warts. Arising on the underside of the head, the mandibles are not normally conspicuous, but in a number of insects they have taken on new functions and have developed accordingly. The male Stag Beetle (Pl.19) has enormous antler-like mandibles, sometimes as long as the rest of the body, but they are of sexual significance only and are not nearly as powerful as one might imagine. The soldier castes of some ant and termite species, however, have muscles worthy of their large mandibles. Large-jawed ants have long been used to stitch wounds in parts of Africa: the ants

The mouth-parts of the cockroach, dissected out to show their structure





Three entirely different modifications of the mouth-parts for taking liquid food

are made to bite into the skin across a cut and are then beheaded, the jaws staying firmly closed and being left in position until the wound has healed.

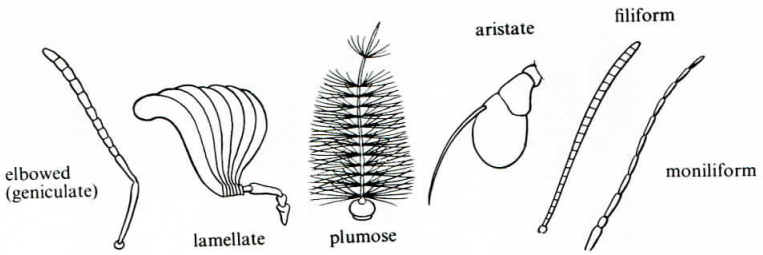
Behind the mandibles there is a pair of maxillae or secondary jaws. In the cockroach these help to hold the food while the mandibles cut it. The palps of the maxillae, resembling short antennae, are well supplied with sense organs and they are concerned with finding food and determining its acceptability. The labium or lower lip is formed by the fusion of two maxilla-like appendages and it performs functions similar to those of the maxillae themselves.

Lying in the middle of the underside of the head, just behind the mouth, is the hypopharynx. It is not one of the paired head appendages and is associated with the ducts of the salivary glands. In the cockroach and most other insects it is a small, tongue-like structure but it is well developed in flies – especially the blood-sucking forms. The mouth-parts are completed by the labrum, a single structure formed from a single plate at the very front of the head. It forms a roof over the region in which the mandibles cut up the food and is aptly called the upper lip. Its lower surface sometimes bears a small lobe called the epipharynx.

Biting mouth-parts similar to those just described are found in most of the lower orders of insects – cockroaches, grasshoppers, dragonflies, and so on – as well as in the more advanced beetles and wasps. Sucking mouth-parts, adapted for liquid food, are found among the butterflies and moths, true bugs, flies, fleas, and a few other insects. There is a great variety among these sucking mouths – witness the difference between the slender proboscis of a butterfly, the needle-like stylets of a bug, and the 'mop' of a house-fly. Nevertheless, they all seem to have evolved from the primitive biting type of mouth-parts by differential development – especially of the maxillae and labium.

The antennae are concerned largely with the senses of smell and touch. They are composed of a number of segments, ranging from one in a few beetles to over 100 in cockroaches, bush-crickets, and some other insects. Among the lower orders of insects the antennae are slender and thread-like, with all segments more or less alike but there is a great deal of variation in the higher orders. The first segment, which is often much longer than the others, is called the scape. This is followed by the pedicel, which is usually a short segment, and the rest of the antenna forms the flagellum. The latter may consist of several separate segments, or else the component segments are fused together. When the scape is particularly long and the rest of the antenna hinges on it the antenna is said to be geniculate or elbowed.

The antennae of certain male moths, including the Emperor Moth (Pl.40), are extremely large and are used to locate their mates. The female moths emit specific



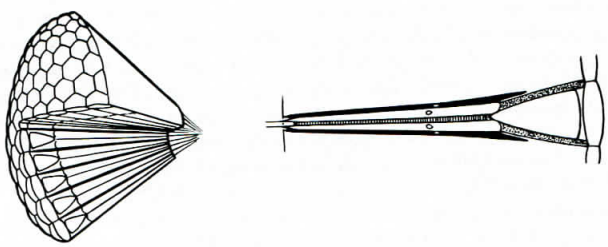
Some types of insect antennae

scents which the males can pick up more than a mile away. The concentration of scent particles at such distances is very low, but the feathery development of the male antennae makes up for this by presenting the largest possible area of receptive cells to detect the scent. As soon as a male picks up the slightest trace of the appropriate scent it turns to fly upwind, and thus eventually reaches the source of the scent.

Insects have two main types of visual receptors – the compound eye and the simple ocellus. A great many species have both types, but one or the other – or both – may be missing. The compound eye is the larger of the two and is quite conspicuous in many insects, but this kind of eye is never found in larvae.

Compound eyes are composed of a number of separate visual units called ommatidia. These are cone-shaped and each has its own lens or facet at the surface of the eye. This arrangement is responsible for the reticulated appearance of the insect eye when seen under a lens. Each ommatidium makes its own image and sends its own signal to the brain, so the insect sees a mosaic image made up of many small pieces. The picture is not sharp but this arrangement of the eye is well suited to detect movement, for any movement in the surroundings results in the stimulation of different ommatidia. The greater the number of ommatidia in the eye, the sharper the picture and the smaller the movements that can be detected. Dragonflies, which capture their food on the wing, have up to 30,000 ommatidia and extremely good sight.

The compound eye, showing how its surface is composed of numerous lenses or facets. Each lens is at the end of a conical body called an ommatidium, shown greatly enlarged on the right. Each ommatidium is insulated from its neighbours by pigmented collars, and light passes straight down to the nerve fibres at the base. Only light rays coming perpendicularly through the lens can reach the nerves, so each ommatidium has a very limited field of view



Their eyes are so large that they appear to take up almost the whole of the head. Associated with their almost complete dependence on sight, the dragonflies have very small, bristle-like antennae.

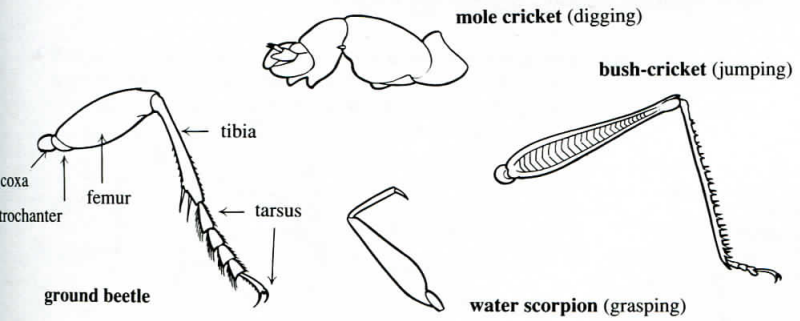
The simple ocelli, when present, are usually three in number and they form a triangle on the top of the head. They are quite small and inconspicuous in most insects, although quite easily seen in bees and wasps and some of the other large hymenopterans. The ocelli have no focusing mechanism but they are very sensitive to changes in light intensity and are thought to control the working of the compound eyes in some way. Larval ocelli are placed on the sides of the head and probably give a vague indication of the nature of the surroundings, sufficient at least for the insect to distinguish between exposed and shaded regions.

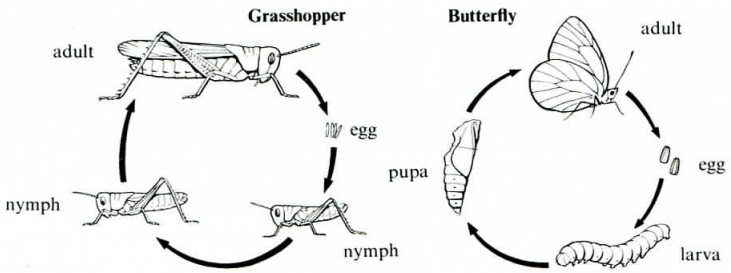
The Thorax The three thoracic segments are named, from front to back, the prothorax, mesothorax, and metathorax. Each segment carries a pair of legs and the wings, if present, are carried on the mesothorax and metathorax. Wings are never found on the prothorax, which is often small and insignificant. The meso- and metathoracic segments are usually fused together, forming the pterothorax, and the two component segments are not always easy to distinguish. The forewings, carried on the mesothorax, are normally larger than the hind wings and in consequence the mesothorax is usually larger than the metathorax. In the Diptera, whose hind wings are reduced to pin-like halteres, the mesothorax makes up almost the whole thoracic region, the prothorax and metathorax being reduced to small rings fore and aft. Among the beetles, whose forewings are modified as protective elytra, the mesothorax is quite small.

The sclerites of the thoracic segments are usually divided into numerous smaller plates and there is an elaborate system for naming them, but only the major divisions are of interest here. The primary sclerites of the dorsal surface – the nota – are each divided transversely into three regions known as the prescutum, scutum, and scutellum, but the divisions of the pronotum and metanotum are usually obscured. Unless otherwise stated, the terms scutum and scutellum refer to the mesothorax.

The pleural sclerites on the sides of the thorax consist basically of an episternum and an epimeron in each segment. The episternum is the anterior of the two and separated from the epimeron by the pleural suture. There are many sub-divisions of these pleural sclerites but they are of no concern here. The ventral sclerites or sterna

A typical insect leg (ground beetle), together with some modifications for specialised functions





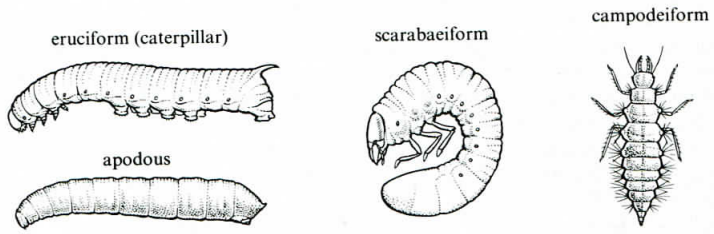
Insect life histories: the partial metamorphosis of the grasshopper - an exopterygote insect - and the complete metamorphosis of the butterfly - an endopterygote

Because of its tough, non-living external skeleton, an insect cannot grow steadily: it has to grow in stages, periodically shedding its coat when it gets too tight. The process is called moulting or ecdysis. The inner layers of the coat are digested away and a new, looser covering is secreted under the old outer skin. By swallowing air or water, the insect then pumps itself up and splits the old skin and crawls out of it. It remains swollen until the new coat has hardened and then, by getting rid of the air or water, it makes room for the next period of growth. An insect may moult anything from once to 50 times during its life, but such extremes are unusual and most insects moult between four and ten times. The stages between moults are called instars.

Winged insects can be split into two groups according to the way in which the wings develop in the young. Among the so-called 'lower insects' – cockroaches, grasshoppers, dragonflies, and so on – the wings develop gradually on the outside of the body and get larger at each moult until they are fully developed. The young stages of these insects are called nymphs and they frequently resemble the adults in general appearance, often inhabiting the same places and eating the same kinds of food. This group of insects is called the Exopterygota, in reference to the external development of the wings. It is also known as the Hemimetabola and, because there is no really dramatic change of form during their lives, the insects are said to undergo a partial metamorphosis.

The other group of winged insects includes the butterflies and moths, beetles, flies, and so on in which the young stages are very unlike the adults. These young stages are called larvae and they often exist on diets quite different from those of

The four basic types of insect larvae



Key to the Orders of European Insects

* Denotes orders not found in the British Isles

1. Insects winged 2
   Insects wingless or with vestigial wings 29

2. One pair of wings 3
   Two pairs of wings 7

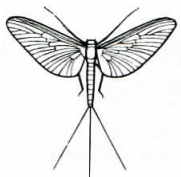
3. Body grasshopper-like, with enlarged hind legs and pronotum extending back over abdomen Orthoptera p. 68

   Insects not like this 4

4. Abdomen with 'tails' 5
   Abdomen without 'tails' 6

5. Insects <5mm long, with relatively long antennae: wing with only one forked vein Hemiptera p. 97

   Larger insects with short antennae and many wing veins: tails long Ephemeroptera p. 52



6. Forewings forming club-shaped halteres Strepsiptera p.161

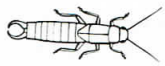
   Hind wings forming halteres (may be hidden) Diptera p. 170

7. Forewings hard or leathery 8
   All wings membranous 13

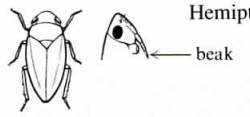
8. Forewings horny apart from membranous tip Hemiptera p. 97

   Forewings of uniform texture throughout 9

9. Forewings (elytra) hard and veinless, meeting in centre line 10
   Forewings with many veins, overlapping at least a little and often held roofwise over the body 11

10. Abdomen ending in a pair of forceps: elytra always short —  — Dermaptera p. 78

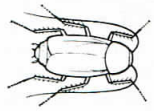
Abdomen without forceps: elytra commonly cover whole abdomen —  — Coleoptera p. 134

11. Insects with piercing and sucking beaks — 

Hemiptera p. 97

Insects with chewing mouths: cerci usually present — 12

12. Hind legs modified for jumping —  — Orthoptera p. 68

Hind legs not modified for jumping —  — Dictyoptera p. 82

13. Tiny insects covered with white powder — 14

Insects not like this — 15

14. Wings held flat at rest: mouth-parts adapted for piercing and sucking —  — Hemiptera p. 97

Wings held roofwise over body at rest: biting mouthparts —  — Neuroptera p. 127

15. Small, slender insects with narrow, hair-fringed wings: often found in flowers —  — Thysanoptera p. 125

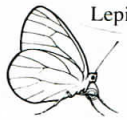
Insects not like this — 16

16. Head extending downwards into a beak — 

Mecoptera p. 163

No such beak — 17

17. Wings more or less covered with minute scales: coiled proboscis (tongue) usually present — Lepidoptera p. 213



Wings usually transparent, although often hairy — 18

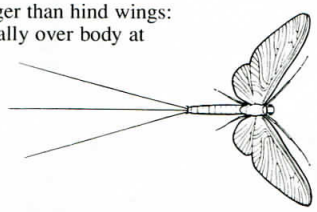
18. Wings with a network of veins, including many cross veins — 19

Wings with relatively few cross veins — 23

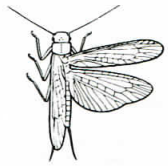
19. Abdomen with long terminal threads — 20

Terminal appendages short or absent — 21

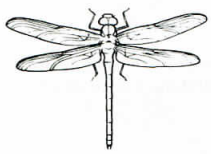
20. Forewings much larger than hind wings: wings held vertically over body at rest: 2 or 3 terminal threads — Ephemeroptera p. 52



Wings more or less equal in size or hind wings larger: wings folded close to body at rest: 2 terminal appendages — Plecoptera p. 64

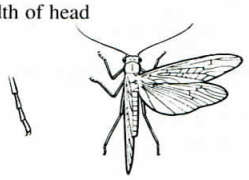


21. Antennae very short: body at least 25mm long — Odonata p. 57

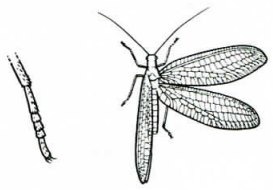


Antennae longer, greater than width of head — 22

22. Tarsi 3-segmented — Plecoptera p. 64

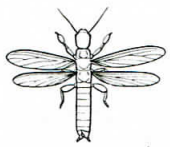


Tarsi 5-segmented — Neuroptera p. 127



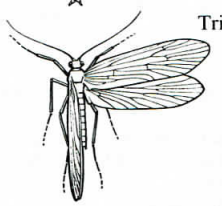
23. Wings noticeably hairy — 24
Wings not noticeably hairy — 25

24. All wings more or less alike: front tarsi swollen



*Embioptera p. 81

Hind wings usually broader than forewings: front tarsi not swollen



Trichoptera p. 245

25. Tarsi with 4 or 5 segments — 26
Tarsi with 1-3 segments — 27

26. All wings alike

*Isoptera p. 86

Hind wings much smaller than forewings

Hymenoptera p. 253

27. Hind wings similar to or larger than forewings: abdomen with cerci

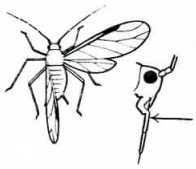
Plecoptera p. 64

Hind wings smaller than forewings: no cerci — 28

28. Tiny insects with at least 12 antennal segments

Psocoptera p. 88

Never more than 10 antennal segments: piercing and sucking beak present



Hemiptera p. 97

29. Insects with slender, twig-like body  *Phasmida p. 77

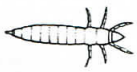
Insects not like this 30

30. Insects with grasshopper-like body and long back legs  Orthoptera p. 68

Insects not like this 31

31. Small, soft-bodied insects living on plants, often under a protective shield or scale  Hemiptera p. 97

Insects not like this 32

32. Minute soil-living insects, < 2mm long and without antennae  Protura p. 48

Insects not like this 33

33. Insects with cerci or other abdominal appendages 34

Insects without such appendages 41

34. Abdominal appendages long and conspicuous 35

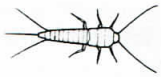
Abdominal appendages short or hidden under body 38

35. Appendages forming pincers 36

Appendages not forming pincers 37

36. Tarsi 3-segmented  Dermaptera p. 78

Tarsi 1-segmented Diplura p. 47

37. Abdomen with 3 long terminal appendages  Thysanura p. 45

Abdomen with only 2 terminal appendages  Diplura p. 47

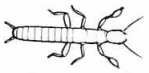
38. Tiny jumping insects with head produced downward into a beak: vestigial wings present  Mecoptera p. 163

No sign of a beak 39

39. Small or minute insects with a forked springing organ under rear end: generally found in soil or decaying vegetation  Collembola p. 48

Insects not like this 40

40. Tarsi usually 4-segmented  *Isoptera p. 86

Tarsi 3-segmented: front tarsi swollen  *Embioptera p. 81

41. Parasites in fur or feathers: insects generally flattened side-to-side or dorso-ventrally 42

Insects not parasitic and not usually flattened 46

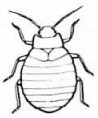
42. Jumping insects flattened from side to side  Siphonaptera p. 165

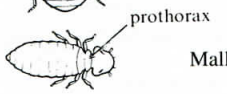
Insects flattened dorso-laterally 43

43. Insects of moderate size: head partly withdrawn into thorax 44

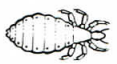
Small or minute insects: head not withdrawn into thorax 45

44. Antennae short: very 'leggy' insects with strong claws well suited to clinging to host mammal  Diptera p. 170

Antennae long: body somewhat circular, with less prominent legs and claws  Hemiptera p. 97



45. Prothorax distinct: biting mouths Mallophaga p. 95

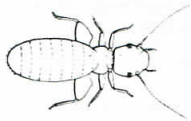
Thoracic segments fused into one unit: sucking mouths  Anoplura p. 96

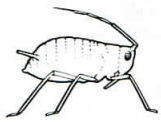
46. Abdomen with pronounced 'waist': antennae often elbowed Hymenoptera p. 253

No such features 47

47. Body > 5mm long, clothed with flattened hairs and scales: wing vestiges present Lepidoptera p. 213

Body usually < 5mm long, naked or occasionally scaly: wing vestiges rarely present. 48

48. Head as wide or nearly as wide as body: biting mouthparts: insects often found among dried materials  Psocoptera p. 88

Head narrower than body: sucking mouthparts: abdomen often with a pair of tubular outgrowths near hind end: insects found on growing plants  Hemiptera p. 97